Asymmetries Between Strange and Antistrange Particle Production in Pion-Proton Interactions*

T.D. Gutierrez[†] *and R. Vogt*

Flavor correlations between the final-state hadron and the projectile have been observed in charm hadroproduction. A strong leading particle effect was seen in the difference between the D^- and D^+ distributions at large Feynman x, $x_F = p_{||}/p_{\rm max}$, with pion projectiles. More recently, hyperon beams have been used to study charm baryon distributions at high x_F. Several of these experiments have also studied the x_F-dependent asymmetry between charm and anticharm baryons, defined as the ratio of, *e.g.*, the difference between the Λ_c and $\overline{\Lambda}_c$ x_F distributions divided by their sums. Recently data are also available in the strange sector [1].

The strange/antistrange baryon asymmetries A_Λ, A_{Ξ^-}, and A_Ω have been measured in π^--induced interactions at 500 GeV [1]. The measurements are around $|x_F| < 0.1$. For $x_F > 0$, A_Λ and A_Ω are nearly independent of x_F while A_{Ξ^-} increases with x_F. At negative x_F, only A_Ω is independent of x_F. The other asymmetries increase as x_F decreases with $A_\Lambda > A_{\Xi^-}$. These measurements are inconsistent with PYTHIA but are consistent with qualitative expectations from recombination models.

One such model that involves recombination with valence quarks is the "intrinsic charm" model. In this picture, the projectile can fluctuate into a Fock state configuration with at least one $c\overline{c}$ pair as well as other light $q\overline{q}$ pairs. These charm quarks are comoving with the other partons in the Fock state and thus can combine with these comoving partons to produce charm hadrons at large x_F. The probability that the projectile fluctuates into a state with the projectile valence quarks and a $c\overline{c}$ pair is $\approx 0.3\%$. The probability for intrinsic states with other $Q\overline{Q}$ pairs scales as the square of the constituent quark mass. Since strange quarks are lighter than charm quarks, the corresponding probability for intrinsic $s\overline{s}$ pairs in the wavefunction should be significantly larger.

We apply the combined leading-twist/intrinsic model of Ref. [2] to strangeness production, inferring the probabilities for the Fock states with 1-3 intrinsic $Q\overline{Q}$ pairs. We calculate the strange hadron distributions in the intrinsic model for $\pi^- p$ interactions and find that the model predicts asymmetries at lower values of x_F than for the more massive charm quarks. We correctly produce the general trends of the $\pi^- p$ data but not the strong increase of the asymmetry at low $|x_F|$, even when intrinsic-model fragmentation is switched off, suggesting that fragmentation is not effective in the intrinsic model. The increase in the asymmetries A_{Ξ^-} and A_Λ with x_F cannot be reproduced unless either the intrinsic cross section is increased greatly or the shape of the leading-twist nonleading distribution is modified. Increasing the intrinsic cross section to obtain agreement with the asymmetries modifies the individual x_F distributions too strongly, destroying agreement with inclusive Ξ^- spectra. Modifying the leading-twist distribution is consistent with all data so far but the inclusive x_F distributions of $\overline{\Xi^-}$ are unavailable. The modified leading-twist distribution alone cannot describe the asymmetries since then A_Λ and A_{Ξ^-} should then be identical in the proton fragmentation region. Precision data are clearly needed, particularly on the antistrange baryon x_F distributions.

[1] E.M. Aitala *et al.* (E791 Collab.), Phys. Lett. **B496** (2000) 9.

[2] T. Gutierrez and R. Vogt, Nucl. Phys. **B539** (1999) 189.

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[†]Physics Department, University of California at Davis